MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

DTC5088 – ANALOG AND DIGITAL COMMUNICATION SYSTEMS

(Diploma of Electronic Engineering)

6 MARCH 2020
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **5** pages excluding the cover page and **2** pages for appendices.

2. Answer **ALL** question.

3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

a) Explain two advantages and two disadvantages of analog communication systems.

[8 marks]

b) By using graphical approach, sketch diagrams that can show the differences between the continuous time signal and discrete time signal.

[4 marks]

c) States three types of signal operations.

[3 marks]

d) Figure 1 is the signal waveform $X(t)$.Plot the signal after doing the following signal operations:

i) $X(2t-5)$.

[5 marks]

ii) $X\left(\frac{3t-2}{4}\right)$.

[5 marks]

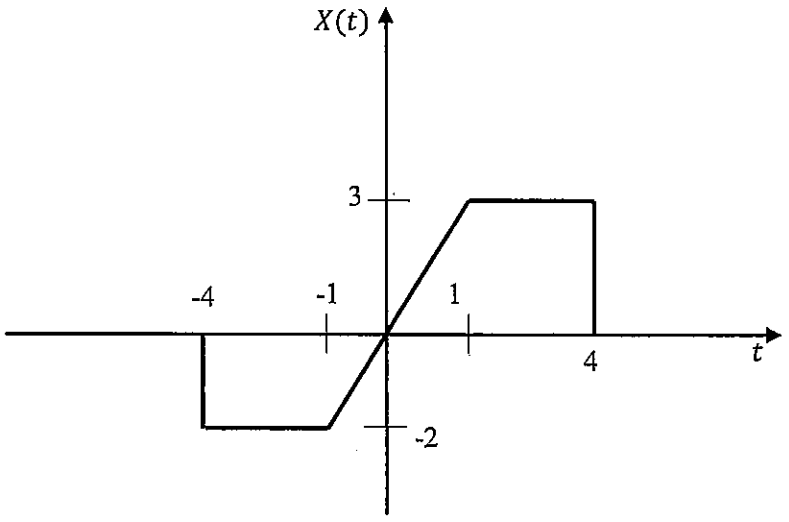

Figure 1

Continued...

QUESTION 2 [25 MARKS]

a) Given $s(t)=\frac{8}{2}\cos(2\pi\times21000t)+\frac{8}{2}\cos(2\pi\times19000t)$ and the amplitude of the carrier frequency is 4 V :

i) Calculate upper-side band frequency, f_{USB} ,lower-side band frequency, f_{LSB} .

[4 marks]

ii) Find the amplitude of modulated signal, A_m.

[2 marks]

iii) Construct a frequency spectrum for the above modulated signal for a single-tone signal.

[3 marks]

b) A frequency modulated signal have the carrier frequency of 3 MHz. Given that signal have the frequency of the modulating signal is 3 kHz and got 0.9 modulation index. Build up the table like table 1 below with all relevant data and sketch the frequency spectrum if it got Amplitude Carrier, $A_c = 5$ V.

Table 1

n	J_n	A_cJ_n	$f_{LSB(n)}$	$f_{USB(n)}$

[10 marks]

c) An Amplitude Modulation superheterodyne receiver that uses high side injection with local oscillators frequency of 2600 kHz receive an RF components of carrier, upper and lower side frequencies of 740 kHz, 810 kHz and 700 kHz. Calculate the IF components of carrier, upper and lower side frequencies.

[6 marks]

Continued...

QUESTION 3 [25 MARKS]

a)

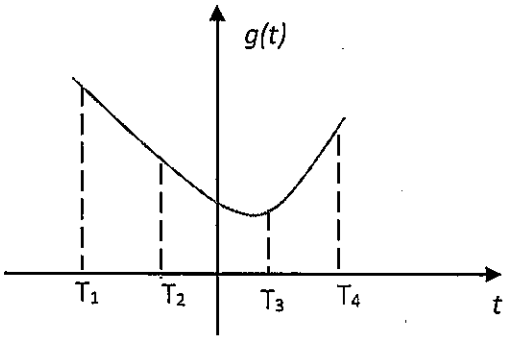

Figure 2

Figure 2 shows an analog signal transmitted from the source. Using the information supplied:

i) Sketch the flat top sampling.

[4 marks]

ii) If the source signal has maximum frequency of 30 kHz, calculate the minimum sampling rate.

[2 marks]

iii) Determine the encoded binary code in the Table 2 below if the quantization level for each sample from T_1 till T_4 is given as follows:

Table 2

Sample time	Quantization Level	Encoded Binary Code
T_1	8	
T_2	5	
T_3	2	
T_4	6	

[4 marks]

Continued...

b) For binary data 11010110, sketch the output, state the baud rate and bit rate of it, when it is converted back into analog waveforms using the following data schemes.

i) ASK.

[4 marks]

ii) 4-PSK.

[4 marks]

iii) FSK.

[4 marks]

c) Draw the constellation diagram for 16-Quadrature Amplitude Modulation with 2 level of amplitude and 8 phases.

[3 marks]

QUESTION 4 [25 MARKS]

a) Explain the definition of unipolar encoding and polar encoding. Use diagram(s) to support your explanations.

[6 marks]

b) Encode the data of "11001110" using:

i) Manchester.

[2 marks]

ii) Differential Manchester.

[2 marks]

iii) NRZ-L.

[2 marks]

iv) Unipolar.

[2 marks]

c) Determine output for the message of 10011010 by using the following method. Show the steps. Consider even parity bit.

i) LRC.

[3 marks]

ii) VRC.

[2 marks]

d) Proof that 100100001 is the correct CRC data generated by a transmitter that agreed to use 1101 as the divisor.

[6 marks]

End of Page.

APPENDIX

(A) Amplitude Modulation

Carrier signal, $s_c(t) = A_c \cos(\omega_c t)$

Modulating signal, $s_m(t) = A_m \cos(\omega_m t)$

Amplitude-modulated signal,

DSB-LC: $s(t) = A_c \cos \omega_c t + \frac{A_m}{2}\cos(\omega_c - \omega_m)t + \frac{A_m}{2}\cos(\omega_c + \omega_m)t$

DSB-SC: $s(t) = \frac{A_m A_c}{2}\cos(\omega_c + \omega_m)t + \frac{A_m A_c}{2}\cos(\omega_c - \omega_m)t$

SSB-SC:

LSB : $s_{LSB}(t) = \frac{A_m A_c}{2}\cos(\omega_c t - \omega_m t)$

USB : $s_{USB}(t) = \frac{A_m A_c}{2}\cos(\omega_c t + \omega_m t)$

(B) AM Superheterodyne Receiver

Local oscillator frequency,

$f_{LO} = f_{RF(C)} + f_{IF(C)}$

$f_{LO} = f_{RF(USF)} + f_{IF(LSF)}$

$f_{LO} = f_{RF(LSF)} + f_{IF(USF)}$

(C) Error correction

r1: bits 1, 3, 5, 7, 9, 11

r2: bits 2, 3, 6, 7, 10, 11

r4: bits 4, 5, 6, 7

r8: bits 8, 9, 10, 11

(D) Bessel table function

TABLE 4-1
Bessel functions of the first kind

	n or order of sidebands																
Modulation Index (m_f)	Carrier Frequency J_0	J_1	J_2	J_3	J_4	J_5	J_6	J_7	J_8	J_9	J_{10}	J_{11}	J_{12}	J_{13}	J_{14}	J_{15}	J_{16}
0.00	1.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.25	0.98	0.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0.5	0.94	0.24	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1.0	0.77	0.44	0.11	0.02	—	—	—	—	—	—	—	—	—	—	—	—	—
1.5	0.51	0.56	0.23	0.06	0.01	—	—	—	—	—	—	—	—	—	—	—	—
2.0	0.22	0.58	0.35	0.13	0.03	—	—	—	—	—	—	—	—	—	—	—	—
2.5	−0.05	0.50	0.45	0.22	0.07	0.02	—	—	—	—	—	—	—	—	—	—	—
3.0	−0.26	0.34	0.49	0.31	0.13	0.04	0.01	—	—	—	—	—	—	—	—	—	—
4.0	−0.40	−0.07	0.36	0.43	0.28	0.13	0.05	0.02	—	—	—	—	—	—	—	—	—
5.0	−0.18	−0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02	—	—	—	—	—	—	—	—
6.0	0.15	−0.28	−0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02	—	—	—	—	—	—	—
7.0	0.30	0.00	−0.30	−0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02	—	—	—	—	—	—
8.0	0.17	0.23	−0.11	−0.29	−0.10	0.19	0.34	0.32	0.22	0.13	0.06	0.03	—	—	—	—	—
9.0	−0.09	0.24	0.14	−0.18	−0.27	−0.06	0.20	0.33	0.30	0.21	0.12	0.06	0.03	0.01	—	—	—
10.0	−0.25	0.04	0.25	0.06	−0.22	−0.23	−0.01	0.22	0.31	0.29	0.20	0.12	0.06	0.03	0.01	—	—
12.0	0.05	−0.22	−0.08	0.20	0.18	−0.07	−0.24	−0.17	0.05	0.23	0.30	0.27	0.20	0.12	0.07	0.03	0.01
15.0	−0.01	0.21	0.04	−0.19	−0.12	0.13	0.21	0.03	−0.17	−0.22	−0.09	0.10	0.24	0.28	0.25	0.18	0.12

Source: E. Cambi, *Bessel Functions*, Dover Publications, Inc., New York, N.Y., 1948. Courtesy of the publisher.

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